MOMENTIVE™
inventing possibilities

CoatOSil*

Additives for High Performance Coatings and Inks

Momentive Performance Materials' CoatOSil* coatings additives are used in a wide variety of industries and applications, including water and solvent-borne coatings, high solids, powder and UV/EB cure coatings, as well as inks. These products may offer multiple advantages:

- Enhanced flow & leveling (eliminate defects)
- Improved slip (reduce coefficient of friction)
- Increased mar resistance
- Control of foam and enhanced air release
- Improved substrate wetting
- Increased gloss
- Anti-blocking (release)

There are three main types of additives: silicone-polyether block copolymers, trisiloxanes and reactive silicone additives.

Silicone-polyether block copolymers

Most CoatOSil additives fall into this category. They have a pendant (grafted) architecture (Figure A) or a linear (ABA) structure (Figure B).

By varying m, x, y and z, a tremendous variety of properties can be achieved.

These CoatOSil silicone-polyethers have a strong effect, at low concentration, on all types of coatings. The silicone part of the molecule provides low surface tension, high surface activity. The effect of a silicone-polyether depends on the type and amount of polyether it contains:

- A molecule with significant silicone content will increase slip and mar resistance; if the silicone content is very high then the additive will act as a defoamer, and provide anti-blocking and release.
- A silicone with high polyethylene oxide content will be compatible with waterborne coatings and it can be even water-soluble (see table on the following page). Such additives help wetting, flow and leveling of waterborne coatings, allowing the coating to be "overcoatable" while providing gloss retention.

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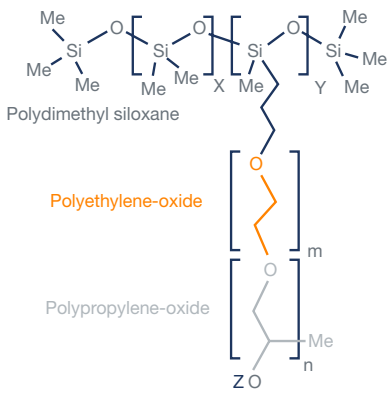
- If the polyether consists of polypropylene oxide, then the copolymer will be compatible with solventborne and high solids coatings and inks and can be used as a flow and leveling (anti-cratering) agent for such formulations.

Trisiloxanes

CoatOSil trisiloxanes have special properties. These molecules are often called 'superspreaders,' because they are excellent wetting and spreading agents, especially in waterborne coatings and inks.

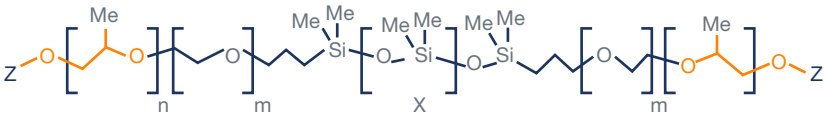
Reactive silicone additives

While most CoatOSil silicone additives act in a non-chemical manner, reactive silicone additives are exceptions due to their high surface activity. These CoatOSil additives react chemically with the resin and thus permanently modify the coating. In these products, the terminal group is an epoxy or an acrylic group.



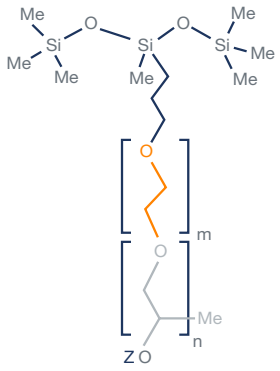
Silicone-polyether block copolymer-pendant structure

Figure A



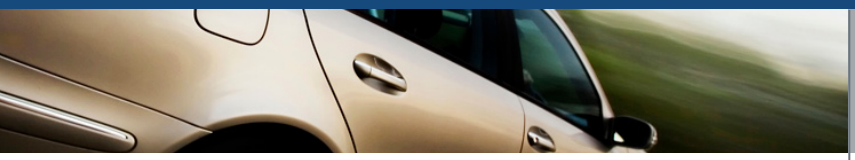
Silicone-polyether block copolymer-linear structure

Figure B



Trisiloxane structure

Figure C



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Typical Properties

Product	Molecular Architecture	End-group (Z)	MW	Surface tension + mN/m or dmy/cm2	Polyether type	Solubility++ in Water
CoatOSil* products:						
CoatOSil 1211C(1)	N/A	N/A	N/A	20.5	N/A	DII
CoatOSil 2812	Linear	H	2000	26.6	All-EO	SDD
CoatOSil 2816	Linear	Me	3,000	29.6	EO/PO	SSS
CoatOSil 3500	Linear	H	2100	25.4	All-EO	SSS
CoatOSil 3501	Pendant	H	8000	Insoluble	All-EO	III
CoatOSil 3505	Linear	H	2800	Insoluble	All-PO	III
CoatOSil 3573	Pendant	Me	10,000	Insoluble	All-EO	III
CoatOSil 7001/ CoatOSil 7001E(2)	Pendant	Me	20,000	28.2	EO/PO	SDD
CoatOSil 7033	Pendant	Me	20,000	31.0	EO/PO	SSD
CoatOSil 7200	Pendant	H	19,000	34.2	EO/PO	SSS
CoatOSil 7210	Pendant	H	13,000	30.3	EO/PO	SDD
CoatOSil 7220	Pendant	H	17,000	26.8	EO/PO	DDD
CoatOSil 7230	Pendant	H	29,000	32.4	EO/PO	SSS
CoatOSil 7500	Pendant	Bu	3000	Insoluble	All-PO	III
CoatOSil 7510	Pendant	H	13,000	Insoluble	All-PO	III
CoatOSil 7550	Trisiloxane	H	400	Insoluble	All-EO	III
CoatOSil 7600	Pendant	Me	4000	25.1	All-EO	SSS
CoatOSil 7602	Pendant	Me	3000	26.6	All-EO	DDD
CoatOSil 7604B	Pendant	H	4000	25.4	All-EO	SSS
CoatOSil 7605	Pendant	Me	6000	30.2	All-EO	SSS
CoatOSil 7607	Pendant	Me	1000	23.4	All-EO	SSS
CoatOSil 7608	Trisiloxane	H	600	21.4	All-EO	SDD
CoatOSil 7650	Pendant	H	3000	23.2	All-EO	SDD
CoatOSil 77	Trisiloxane	Me	600	20.5	All-EO	DDD
Epoxy reactives:						
CoatOSil MP200	N/A	Epoxy/Methoxy	N/A	Insoluble	No polyether	

S: soluble; D: dispersible; I: insoluble; EO: Polyethylene-oxide;
PO: polypropylene-oxide; COF: coefficient of friction; F/L: flow and leveling
(1) Blend of various silicone-polyethers.
(2) For Europe

+ 0.1% aqueous solution, ambient temperature, using Du Nouy Ring or Wilhelmy plate method
++ At 77°F (25°C), solubility at 0.1%, 1% and 5%.
+++ Applications in bold are most typical

	Typical applications in various types of coatings and inks +++				
	Solubility++ in Hexane	Water-borne	Solvent-based and high solids	Radiation cure UV/EB	Powder Coating
	SSD	F/L substrate wetting, air release	Wetting, F/L substrate wetting, air release	Wetting, F/L, substrate wetting, air release	
	SII	Slip, mar resist, COF reduction; defoaming	Defoaming, COF reduction, slip, mar resistance		
	SDD	Slip, mar resist	F/L	F/L	
	III	F/L, slip	Substrate wetting, defoaming, F/L, gloss	F/L, COF reduction, slip, mar resistance	
	SSD	Defoaming, antiblocking, COF reduction	Defoaming, antiblocking, COF reduction	Defoaming, COF reduction, slip, mar resistance	
	SSS	Defoaming, slip	F/L, slip, mar resist, gloss retention, defoaming	COF reduction, mar resistance, slip	
	SSI	Defoaming, antiblocking, slip	Defoaming, antiblocking, slip, COF reduction	Defoaming, COF reduction, slip, mar resistance	
	III	F/L, substrate wetting, air release	Wetting, F/L	F/L, substrate wetting	
	III	F/L, substrate wetting, air release	F/L, substrate wetting	F/L	F/L, gloss
	III	F/L, wetting	F/L		
	III	Defoaming, slip	F/L		
	SSS	Defoaming	F/L, gloss		
	III	Defoaming	F/L		
	SSS	Defoaming	F/L, wetting, gloss	F/L, gloss	
	SSS	Defoaming	F/L, defoaming	Defoaming	
	SSS	Defoaming	Air release, wetting		
	III	F/L	F/L		
	SII	Slip, mar resist, F/L, antiblocking	Slip, COF reduction, mar resistance	F/L, COF reduction, slip, mar resistance	F/L, gloss
	III	F/L, wetting	F/L	F/L	
	III	F/L, wetting, gloss	F/L, gloss	F/L	F/L, gloss
	SII	Substrate wetting, F/L, wetting	Wetting, substrate wetting	F/L, wetting	
	III	F/L, gloss, air release	Air release, wetting, F/L, gloss	F/L, gloss, wetting, air release	
	III	Slip, mar resist	F/L		
	SSS	Air release, wetting, substrate wetting F/L	Wetting, substrate wetting, F/L, air release	F/L, substrate wetting, air release	
		Adhesion promoter & crosslinker	Adhesion promoter & crosslinker		Adhesion promoter & crosslinker

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Choosing the right CoatOSil* additive for the job

The effect of silicone additives on a coating strongly depends on their mutual compatibility. Compatibility is controlled by the amount of polyethylene oxide (EO), polypropylene oxide (PO) and polydimethylsiloxane (PDMS) in a molecule. This is illustrated for Momentive CoatOSil additives products in the triangle diagram below.

Most properties (except wetting) of a silicone-polyether additive can be predicted from their position on the triangle diagram. (For wetting, CoatOSil 1211 non-foaming wetting agent and trisiloxanes should always be considered.)

Each vertex of the triangle respectively represents

1) 100% (pure) PDMS (silicone)

2) polyethylene oxide ("EO")

3) polypropylene oxide ("PO").

The base of the triangle represents polyalkylene oxide (no silicone).

Depending on its locus relative to the corners of the triangle, each CoatOSil additive offers varying properties. For example:

- Additives at the top of the triangle have more silicone properties, such as defoaming, anti blocking, release and slip.
- Additives near the EO vertex are water soluble and are good flow, leveling and wetting agents, especially for waterborne systems (see table).
- Additives near the PO vertex are oil soluble (see table) and are good leveling agents for solventborne and high solids coating and inks.

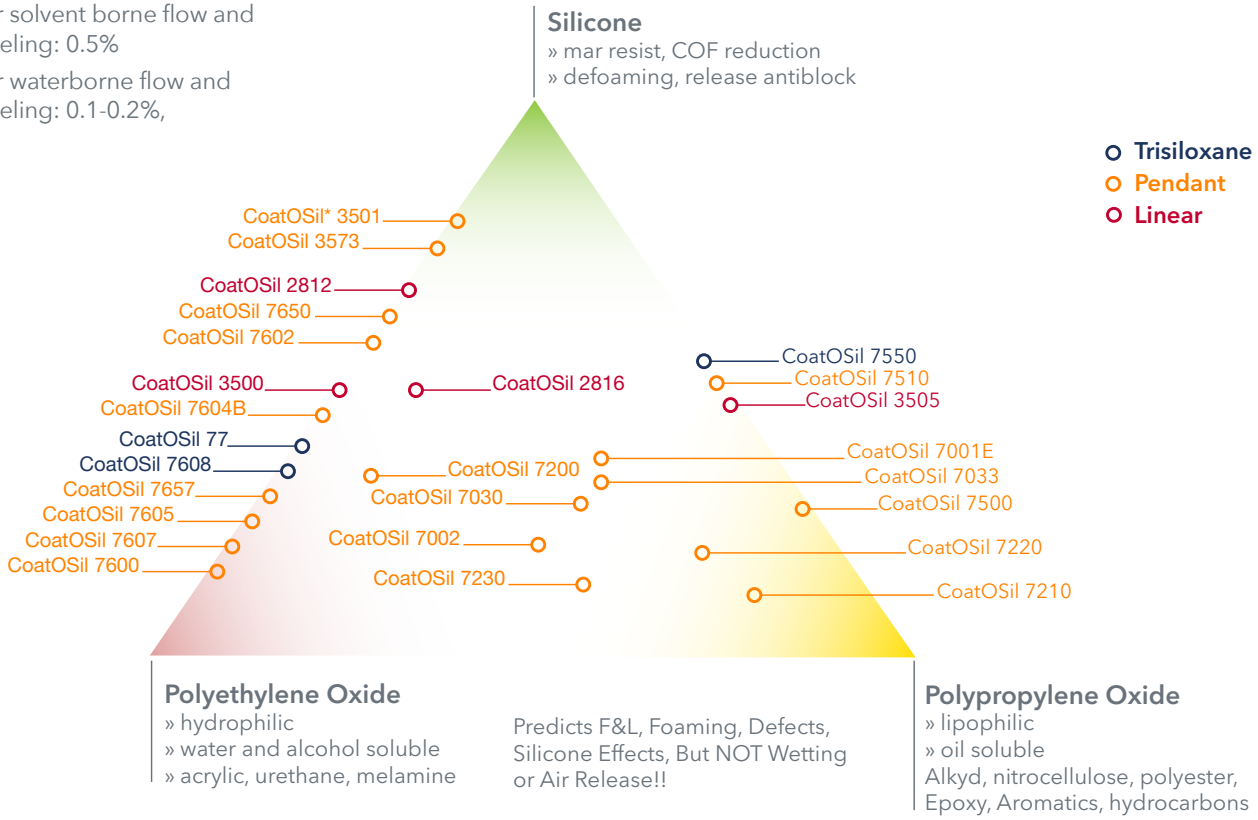
There are often multiple requirements for any particular application. For example, a coating might require good leveling, as well as improved mar resistance, with nonfoaming properties. In cases like this, the best additives are often found in the midsection of the triangle (CoatOSil additives 3500, 7602, 7001, etc.)

Optimal CoatOSil additive concentration depends on the type and composition of the coating as well as the required functionalities of the silicone additive. A ladder study may be considered strongly, in order to find the optimum additive concentration.

Typical starting concentrations for a ladder study:

- For antifoaming: 0.1-0.2%;
- For slip and mar resistance: 0.5%
- For solvent borne flow and leveling: 0.5%
- For waterborne flow and leveling: 0.1-0.2%,
- For powder coatings: 0.2-0.3% and
- For radiation cured systems: 1% (based on the weight of the coating).

CoatOSil additives are essentially silicone oil (polydimethyl siloxane). Most CoatOSil products are solventless (100% actives); most CoatOSil silicone-polyethers are soluble in methanol, acetone, xylenes, dimethyl-chloride and IPA; and most of them are liquids at ambient temperature. The exceptions are CoatOSil 7605 additive and CoatOSil 2400 additive, which are waxy solids, making them especially useful in powder coatings.



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